MIDDLE FORK JOHN DAY RIVER

AND TRIBUTARIES

FISH HABITAT IMPROVEMENT

IMPLEMENTATION PLAN

USDA FOREST SERVICE
MALHEUR NATIONAL FOREST

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ABSTRACT

A habitat improvement program for wild spring chinook salmon and summer steelhead is being implemented on the Middle Fork John Day River (MFJDR) and tributaries. In a coordinated and comprehensive approach, the Oregon Department of Fish and Wildlife (ODFW) will implement habitat improvement on private lands while the U.S. Forest Service (USFS) will implement habitat improvement on Malheur National Forest lands, The two agencies plan to share resources such as boulder and riprap sites, etc., in order to facilitate the most cost effective approach. This implementation plan identifies existing habitat problems, goals and objectives, solutions, priorities, estimated project costs, and associated fishery benefits. The plan is a working document designed to identify project areas and costs for implementation of projects from April 1, 1988 to March 31, 1991, This document will be reviewed periodically and may be updated based on more detailed information as it becomes available.

The MFJDR above Big Creek is in mixed blocks under private and National Forest ownership. About 12 miles of the main Middle Fork and over 100 miles of tributary streams within the boundaries of the Malheur National Forest provide anadromous fish habitat (Figure 6). This plan provides for treatment of the 12 miles of the main MFJDR and 4 miles of tributaries to the MFJDR under National Forest management (Figures l-4). Limiting factors in the MFJDR are adult holding areas and rearing habitat for spring chinook, and rearing habitat for summer steelhead. Limiting factors in tributaries are primarily associated with rearing habitat for juvenile chinook and steelhead. Present rearing conditions are less than optimum due to: 1) low pool/riffle ratios, 2) lack of instream cover; 3) high summer water temperatures; 4) lack of habitat diversity: 5) lack of channel stability and 6) sediment loading. Many of these limiting factors are inter-related.

Implementation is scheduled for April 1, 1988 through March 31, 1991. Primary treatment techniques proposed include: structural improvements for adult and juvenile passage (mouth of Caribou Creek); riparian protection (2,001) feet of juniper placement); structural streambank stabilization (3,600 feet); and structural rearing habitat improvements (16 miles). Treatment strategies are dependent on a variety of factors including existing riparian and aquatic habitat conditions, cost effectiveness, risk, and compliance with other resource allocations.

Program benefits include increased wild chinook and steelhead production, improved riparian habitat, improved water quality, and improved quantity of seasonal flow distribution. Total annual increases in smolt production from implementation of projects proposed for BPA funding on the Malheur NF are estimated to be 17,580 chinook and 5,200 steelhead.

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I. INTRODUCTION

Since 1980, the Malheur National Forest has been pursuing an agressive program on anadromous fish habitat improvement. Projects have been funded by Knutsen-Vandenberg (KV)* and appropriated Forest Service funding; and since 1982 funding has also been provided by the Bonneville Power Administration (BPA) as part of the Northwest Power Planning Council's Fish and Wildlife Program under Measure 703 (c) Action Item 4.2. Since BPA funded activities were initiated in 1982, approximately $519,500 has been spent on fish habitat improvement on the Malheur National Forest, Since 1980, approximately $172,700 of KV and appropriated Forest Service funding has also been spent. Completed projects include log and boulder weirs, jetties, fencing, deflectors, passage improvements, riprap blankets, and boulder placements. Table 1 displays data on streams treated on the Malheur National Forest, including costs, funding source, and amount of work accomplished.

Log weirs and boulder placements provide increased pool area and instream cover. Deflectors and jetties provide cover and reduce sedimentation caused from the undercutting of stream banks. Fencing has been done where needed to control cattle and allow recovery of riparian areas. Riprap - both rock and vegetative - has been used to stabilize streambanks, thereby reducing sedimentation. Cover is also provided along the edge of the riprap.

In January 1984, the Confederated Tribes of the Umatilla Indian Reservation issued "Working Paper, John Day River Basin: Recommended Salmon and Steelhead Habitat Improvement Measures" (James, 1984). This was the result of a planning effort funded by BPA, and has served as the basis for much of the planning that has followed. There have been changes and additions to the list of projects presented in this document, as more on-the-ground evaluation has been done; but the basic project listing is still valid. The Middle Fork John Day River (MFJDR) portion of the project list from that document is included as Table II.

The Middle Fork John Day River (MFJDR) implementation plan supplements this on-going fish habitat improvement program in the MFJDR, The goals of the passage, riparian, and instream work are to maintain wild gene pools and increase production of anadromous fish, These goals are an effort to offset losses incurred by operation of the mainstream Columbia River dams. The project is being implemented by the Malheur National Forest in cooperation with the ODFW, Confederated Tribes of the Umatilla Indian Reservation, and the Grant Soil and Water Conservation District. The Forest Service is responsible for implementation of improvement activities on National Forest lands, while ODFW is responsible for implementation on private lands.

* The Knutsen-Vandenberg Act of June 9, 1930 as amended by the National Forest Management Act of October 22, 1976 requires a timber sale purchaser to deposit money to finance the cost of reforestation, timber stand improvement and other activities to protect and improve-the future productivity of renewable resources within the timber sale area. This includes fish and wildlife habitat improvements.

TABLE I

STRUCTURAL FISH HABITAT IMPROVEMENT
MALHEUR NATIONAL FOREST

SOUTH FORK JOHN DAY RIVER

YEAR	STREAM	WEIRS	DEFLECTORS	BOULDER PLACEMENTS	RIPRAP (FEET)	MILES TREATED	OTHER	TOTAL COSTS	FUNDING SOURCE
1983	Murderer's	22	0	50	0	1 3/4	0	See FY 83 Total	BPA
1983	Deer	94	0	135	0	5	0	Total FY 83 $63,500	BPA
1983	Tex	2	0	0	0	1/4	0	$1,500	FS
Subtotal SFJFR		118	0	185	0	7	0	$63,500 $1,500	BPA FS
TOTALS Malheur NF		1,024	128	2,092	5,565	73	see above	$172,670 $519.500 $692,170	FS/KV BPA

TABLE I

STRUCTURAL FISH HABITAT IMPROVEMENT
COMPLETED PROJECTS: 1980 - 1987
MALHEUR NATIONAL FOREST

MIDDLE FORK JOHN DAY RIVER

YEAR	STREAM	WEIRS	DEFLECTORS	BOULDER PLACEMENTS	RIPRAP (FEET)	MILES TREATED	OTHER	TOTAL COSTS	FUNDING SOURCE
1982	Camp	283	0	0	0	14	* 2 miles fence	$83,700 $76,000	FS BPA
1986	Beaver	37	4	30	0	2	0	See FY 86 Total	BPA
1986	Big Boulder	0	0	40	0	1/2	0	See FY 86 Total	BPA
1986	Davis	4	15	110	0	2	0	See FY 86 Total	BPA
1986	Vincent	67	20	190	400	3	** 2 channel changes	See FY 86 Total	BPA BPA
1986	Vinegar	2	9	30	300	1/2	0	$141,000 Total FY 86 Projects	BPA
1987	Squaw	81	22	115	385	4	0	See FY 87 Total	BPA

TABLE I

STRUCTURAL FISH HABITAT IMPROVEMENT
MALHEUR NATIONAL FOREST

MIDDLE FORK JOHN DAY RIVER
continued

YEAR	STREAM	WEIRS	DEFLECTORS	BOULDER PLACEMENTS	RIPRAP (FEET)	MILES TREATED	OTHER	TOTAL COSTS	FUNDING SOURCE
1987	Clear	10	0	0	0	1	0	See FY 87 Total	BPA
1987	Dry Fork Clear	118	3	10	400	4	0	See FY 87 Total	BPA
1987	Deerhorn	0	10	50	0	1 l/4	*** 200' channel-ization (at mouth)	See. FY 87 Total	BPA
1987	Plaoer Gulch	40	6	25	3.900	2		$120,000 Total FY 87	BPA
198-i	Granite Boulder	14	3	100	150	3 1/2	0	$28,760	KV
Subtotal Middle	Fork	656	92	700	5535"	36 314	see footnotes	$337,000 $112,460	BPA FS/KV

* Extension of existing corridor fence. Prior to 1980, 8 miles of corridor fence was built with FS funds.
** Put stream back into natural channel.
#99 Channelization at mouth of stream to provide passage; access 2 miles of stream.

TABLE I

STRUCTURAL FISH HABITAT IMPROVEMENT
MALHEUR NATIONAL FOREST

MAINSTEM JOHN DAY RIVER

YEAR	STREAM	WEIRS	DEFLECTORS	BOULDER PLACEMENTS	RIPRAP (FEET)	MILES TREATED	OTHER	TOTAL COSTS	FUNDING SOURCE
1980	Reynolds	3	0	800	0	4	0	$13,210	FS
1981	Deardorff	41	0	0	0	5	0	$25,000	FS
1984	East Fork Beech	59	20	220	0	6	500 shrubs planted	See FY 84 Total $500	BPA FS
1984	Canyon	48	13	100	0	6	0	$91,000 Total FY84	BPA
1985	Mainstem John Day	40	0	70	0	5	0	$28,000	BPA
1985	Hall	4	0	0	0	l/4	0	$1,800	Kv
1987	Hall	8	0	0	0	1	0	$3,200	KV
1987	Dixie	47	3	20	30	2	0	$15,000	KV
Subtotals Mainstem JDR		250	36	1210	30	29 l/4	planted 500 shrubs	$119,000 $58,710	BPA FS/KV

TABLE II

FROM "WORKING PAPER"
JOHN DAY RIVER BASIN

ANADROMOUS FISH STREAMS WITHIN THE JOHN DAY DRAINAGE WHICH HAVE THE HIGHEST PRIORITY FOR HABITAT IMPROVEMENT

Stream	Species	Priority[1]	Miles Needing Work			Mi. Riparian Improvement		No. Instr. Struct.		Type Of Work Or Structure[4]	Cost Estimate by Land Ownership		
			Public	Private	Total	Protection[2]	Bank Stab[3]	Boulders	Other		Public	Private	Total
Middle Fork													
Middle Fork[8]	Ch, Stld	1	10.0	30.0	40.0	25.0	2.0	8,000	415	BWDPC	261,000	684,000	945,000
Camp Cr[5]	Ch, Stld	2	11.8	2.0	13.8	2.0	0	1,380	69	BD	128,000	22,000	150,000
Lick Cr[5]	Stld	2	5.0	0	5.0	0	0	500	25	BD	50,000	0	50,000
W Fk Lick Cr	Stld	2	2.0	0	2.0	0	0	200	10	BD	20,000	0	20,000
Bridge Cr	Stld	3	9.0	0	9.0	0	0	900	90	BDW	135,000	0	135,000
Big Cr	Ch, Stld	4	5.0	2.0	7.0	0	0	700	70	BDW	75,000	30,000	105,000
Big Boulder Cr	Ch, Stld	5	5.0	5.0	0	0	0	500	50	BDW	75,000	0	75,000
Wray Cr	Stld	5	1.6	0	1.6	0	0	160	16	BDW	24,000	0	24,000
Long Cr	Stld	6	6.0	14.0	20.0	10.0	0.5	2,000	200	BDW	112,000	260,500	372,500
Vinegar Cr	St.d	7	6.5	0	6.5	0	0	650	65	BDW	97,500	0	97,500
Granite Boulder Cr	Ch, Stld	8	4.0	4.0	0	0	0	400	40	BDW	60,000	0	60,000
Clear Cr	Ch, Stld	9	8.0	1.5	9.5	1.5	0.5	950	95	BDW	138,000	26,000	164,000
Beaver Cr	Stld	10	2.3	0	2.3	2.3	0	230	23	BDW	48,000	0	48,000
Ruby Cr	Stld	11	2.0	0	2.0	1.0	0	200	20	BDW	36,000	0	36,000
Bear Cr	Stld	12	2.0	0	2.0	0	0	200	20	BDW	30,000	0	30,000
Davis Cr	Stld	13	3.0	0	3.0	0	0	300	30	BDW	45,000	0	45,000
Squaw Cr	Ch, Stld	14	5.0	0	5.0	3.0	0	500	50	BDW	93,000	0	93,000
Indian Cr	Ch, Stld	15	4.0	2.0	6.0	0	0	200	30	BDWP	10,000	30,000	40,000
Sub-Basin Totals			92.2	51.5	143.7	44.8	3.0	17,970	1,318		1,437,500	1,052,500	2,490,000

To facilitate accomplishment of the project goals in the most cost effective manner possible, an implementation plan identifying habitat problems and solutions, project priorities and costs, and fishery benefits has been prepared.

The objectives of this implementation plan are:

1. Identify major limiting factors for wild spring chinook and summer steelhead in the MFJDR and tributaries.
2. Present strategies to modify those limiting factors and increase anadromous fish production.
3. Present a schedule for implementation of habitat improvement activities.
4. Present implementation cost estimates for budget planning purposes.
5. Estimate fishery benefits from habitat improvements.

An attempt has been made to provide for completion of the highest priority enhancement activities by March 31, 1991. Based on the schedule of proposed projects, the Malheur National Forest expects to complete high priority BPA financed fish habitat improvement work in the MFJDR and tributaries by that date.

It is anticipated that funding sources such as Knudsen-Vandenberg and appropriated FS funds will finance most remaining fish habitat improvement needs after that date (see Table III). Other projects may be identified in the future, but they will be covered under the John Day River Sub-basin Plan, which is now being developed. At this time, we see Bridge Creek as the highest probability for a future BPA funded project. This stream has a man-caused passage barrier on private land near the mouth of the stream. It parallels U.S. Highway 26, and fish habitat condition has been adversely affected by encroachment of the highway, by right-of-way clearing and vegetation management along the highway. If the passage problem is corrected, fish habitat improvement work on Bridge Creek within the Malheur National Forest would be a suitable candidate for funding from BPA.

Priority projects for BPA funding on the Malheur N.F. in the Mainstem John Day River (JDR) and the lower South Fork John Day River (SFJDR) have been completed. Potential projects in the upper SFJDR are contingent on providing fish passage at Izee Falls, on BLM land, This project is currently being evaluated under a separate BPA funded project. We do not expect it to be completed prior to 1991, or completion of the John Day River Sub-basin Plan, so we are not preparing any proposals for BPA funded projects in the upper SFJDR at this time.

Coordination for the projects proposed in this implementation plan is being done under the environmental assessment process regularly used by the Forest Service, as prescribed by the National Environmental Policy Act (NEPA). In addition to coordination with other resource specialties within the Forest Service, ODFW is closely involved with the process, and adjacent private landowners have been notified of the proposal, so that their comments can be included in the analysis.

TABLE III

The following is a summary of anadromous fish habitat improvement needs and accomplishments for the Malheur N. F, This includes the status of the ongoing BPA program on the Forest. It also includes projects and proposals with funding sources other than BPA, to show how the BPA program fits in with other fish habitat management activities on the Forest.

In doing the analysis to identify future BPA projects, we have generally followed the philosophy of using BPA funding as a supplement to other funding sources for fish habitat improvement work. Thus, if we think we will be able to accomplish a project with K-V funding, or some other source, within the next ten years, we have not identified it as a priority for BPA funding,

BPA funded anadromous fish habitat improvement projects have been accomplished on the Malheur N.F. since 1982. Concurrent with this activity, we have continued doing basic fish habitat surveys and identifying potential projects during timber sale and other project planning. The following table is a summary of major habitat improvement needs identified and projects accomplished since 1980,

Summary of Identified Anadromous Fish Structural Habitat Improvement Needs
Malheur National Forest, John Day River Basin
as of September 15, 1987

Stream Name	Treatment Needed	Done- $ Source	To Do- $ Source	Notes
SOUTH FORK JOHN DAY R.				
Deer Cr	Yes	BPA	KV	most done 1983; small areas left
Murderers Cr	Yes	BPA	KV	most done 1983; small areas left
Tex Cr	Yes	BPA	KV	part done 1983; KV start in 1988
Tribs Above Izee Falls	Yes		KV	BPA funding dependent on passage at Izee Falls - KV could be for resident fish

Stream Name	Needs Treatment	Done- $ Source	To Do- $ Source	Notes
MAINSTEM JOHN DAY R,				
Beech Cr & Tribs	Yes		KV/BPA	limited BPA needs
East Fork Beech Cr	Yes	BPA		done 1984
Call Cr	No			
Canyon Cr & Tribs	Yes	BPA	KV	BPA part done 1984
Deardorff Cr	Yes	FS		done 1981
Dixie Cr	Yes	KV		done 1987
Fields Cr	Yes		KV	limited work needed
Hall Cr	Yes	KV		done 1985 & 1987
Mainstem JDR	Yes	BPA		done 1985
Rail Cr	No			
Reynolds Cr	Yes	FS		done 1980
Roberts Cr	Yes	BPA		done 1985
NORTH FORK JOHN DAY R.				
Deer Cr	Yes		KV	est. 1990
Fox Cr	Yes		KV	est. 1990

Stream Name	Needs Treatment	Done- $ Source	To Do- $ Source	Notes
MIDDLE FORK JOHN DAY R.				
Mainstem above Highway 7""	Yes		BPA	1988 proposal
Camp Cr *	Yes	BPA/FS	BPA	1982 project done with combined BPA and Forest Service funds To Do: 1 mile land exchange
Ruby Cr	Yes		KV	est. 1989
Caribou Cr**	Yes		BPA	1988 proposal: passage and instream
Butte Cr**	Yes		KV/BPA	1988 proposal, to supplement KV
Long Cr +	Yes		KV/BPA	limited BPA supplement to KV
Mainstem below Highway 7 **	Yes		BPA	est. 1989 - 1991 proposal
Summit Cr	Yes		KV	low priority for BPA
Idaho Cr *	Yes		BPA	low priority
Crawford Cr *	Yes		BPA	low priority; low potential
Squaw Cr	Yes	BPA		done 1987
Clear Cr	Yes	BPA		done 1987
Dry Fork Clear Cr	Yes	BPA		done 1987
Bridge Cr *	Yes		KV/BPA	passage at mill pond on private land needed first
Vinegar Cr *	Yes	BPA	KV/BPA	small part BPA priority done 1986: KV priority, est. 1990-1992 low BPA priority (access)
Placer Gulch	Yes	BPA		done 1987
Davis Cr	Yes	BPA		done 1986
Vincent Cr	Yes	BPA		done 1986
Deerhorn Cr	Yes	BPA		1987; passage at mouth

Stream Name	Treatment Needed	Done- $ Source	To Do- $ Source	Notes
Little Boulder Cr	Yes		KV/BPA	1988, BPA supplement to complete treatment on stream
Little Butte Cr	Yes		KV	small part
Granite Boulder Cr	Yes	KV		1987
Beaver Cr	Yes	BPA		1986
Sunshine Cr	Yes		KV	low priority
Dry Cr *	Yes		BPA	low priority; low potential
Big Boulder & Tribs	Yes	BPA	KV	1986 BPA part done; high priority fish & watershed KV, est 1990
Coyote Cr	Yes		KV	low priority
Elk Cr	No			
Deep Cr *	Yes		BPA	low priority; limited need
Bear Cr	Yes		KV	limited access now
Mosquito Cr	No			
Big Cr & Tribs *	Yes		KV/BPA	limited BPA supplement to KV
Lick Cr	Yes	BPA/PM		1982 part of Camp Cr project
Cottonwood Cr	Yes		KV	low intensity treatment
Cougar Cr	Yes		KV	low priority
Slide Cr *	Yes		BPA	land exchange; priority, BUT no access at this time
South Fork Long Cr	Yes		KV	limited access

* Potential future BPA funding requests,. after completion of John Day River Sub-basin Plan. Deferred because of access, priority, or because the project needs to be combined with some other project in the area to be viable.

**Projects included in Implementation Plan.

II. DESCRIPTION OF THE MIDDLE FORK JOHN DAY RIVER

A. General Features

The MFJDR originates at Phipps, Meadow in T,llS.) R.35E; Section 25. Crawford, Summit, and Squaw Creek form the headwaters from which the MFJDR flows generally northwest for 75 miles before entering the North Fork John Day River (see maps, Figures 1 & 2), The MFJDR flows through several distinct land and soil types. Generally, the upper reaches are moist meadow types composed of silt and clay loams having soil depths greater than 24 inches. Lower reaches are comprised of Columbia River basalt formations, Stream gradient varies but generally averages less, than 3% on National Forest lands.

Hydrologically, the discharge pattern on the MFJDR is characterized by high spring runoff from winter snow melt combined with spring rains. Peak runoff usually occurs in April and May. Approximately 70% of the annual precipitation falls from November thru May, mainly in the form of snow. The MFJDR is characterized by low flows in August and September. Average annual rainfall varies from 9 to 40 inches in the subbasin. The flora of the MFJDR is dominated by mixed conifer forests with moist meadows in the upper reaches and dry juniper and grasslands in the lower reaches,

B. Land Use Features

Forest products and livestock agriculture are the major industries. Roads and railroads paralleling and crossing the river have also had long term effects, Mining has had a major influence on some sections of the river. Active mining claims still persist with the level of activity dependent on the price of precious metals, Minimum flows for the MFJDR were adopted in 1985 by the Oregon Water Resources Department.

Many timber stands along the MFJDR have been harvested and,the site converted to a non-timbered condition, This applies to most of the private land and to those portions of the river now under Forest Service management which were dredged. Timber harvest has also taken place on Forest Service lands, and the sites are in various stages of forest succession. These reaches of the MFJDR which are still forested are generally in better 'riparian and fish habitat condition than the rest of the river, Hardwoods have also been removed or reduced along much of the river, In some cases this was intentional, as for clearing the land for pasture on private lands. In other cases the reduction of hardwoods has been a side effect of other management activities.

Livestock grazing has occured in the riparian area along the MFJDR on both private and Forest Service land since before 1900. On private land this is the predominant management activity now. On Forest Service lands, some grazing still occurs also, There are now five separate pastures along the main MFJDR on FS lands. Reach #5, near Galena is corridor,fenced and receives no scheduled livestock use, .Reach-#4, near Gibbs Creek, is a small pasture with a rest rotation use pattern, Under the current rotation, use on this pasture is about 7 to 15 days. The other three are pastures which include fairly large

UNITED STATES
DEPARTMENT OF THE INTERIOR
GEOLOGICAL SURVEY
MODIFIED FOR USDA FOREST SERVICE USE

FIGURE 1

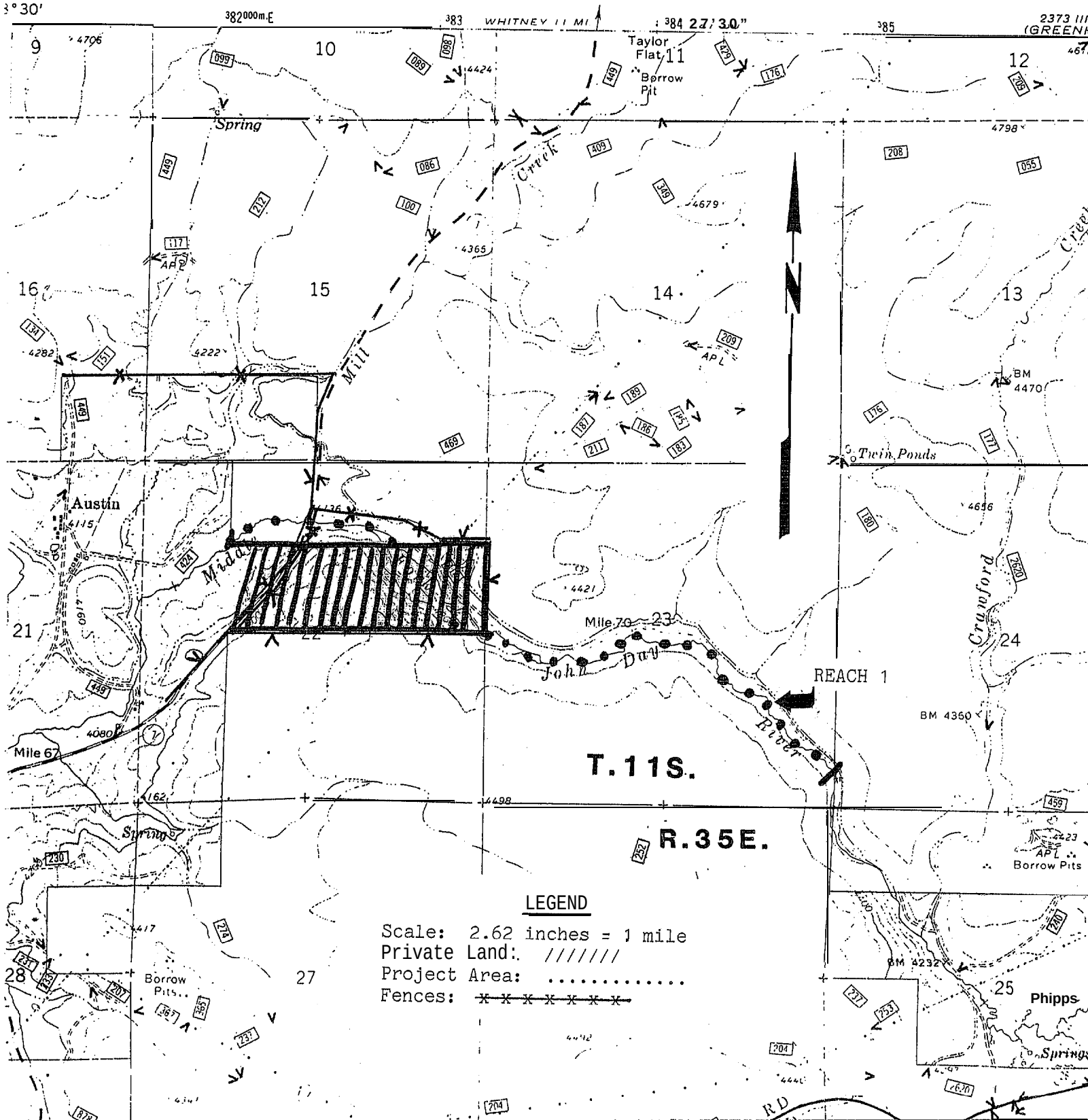
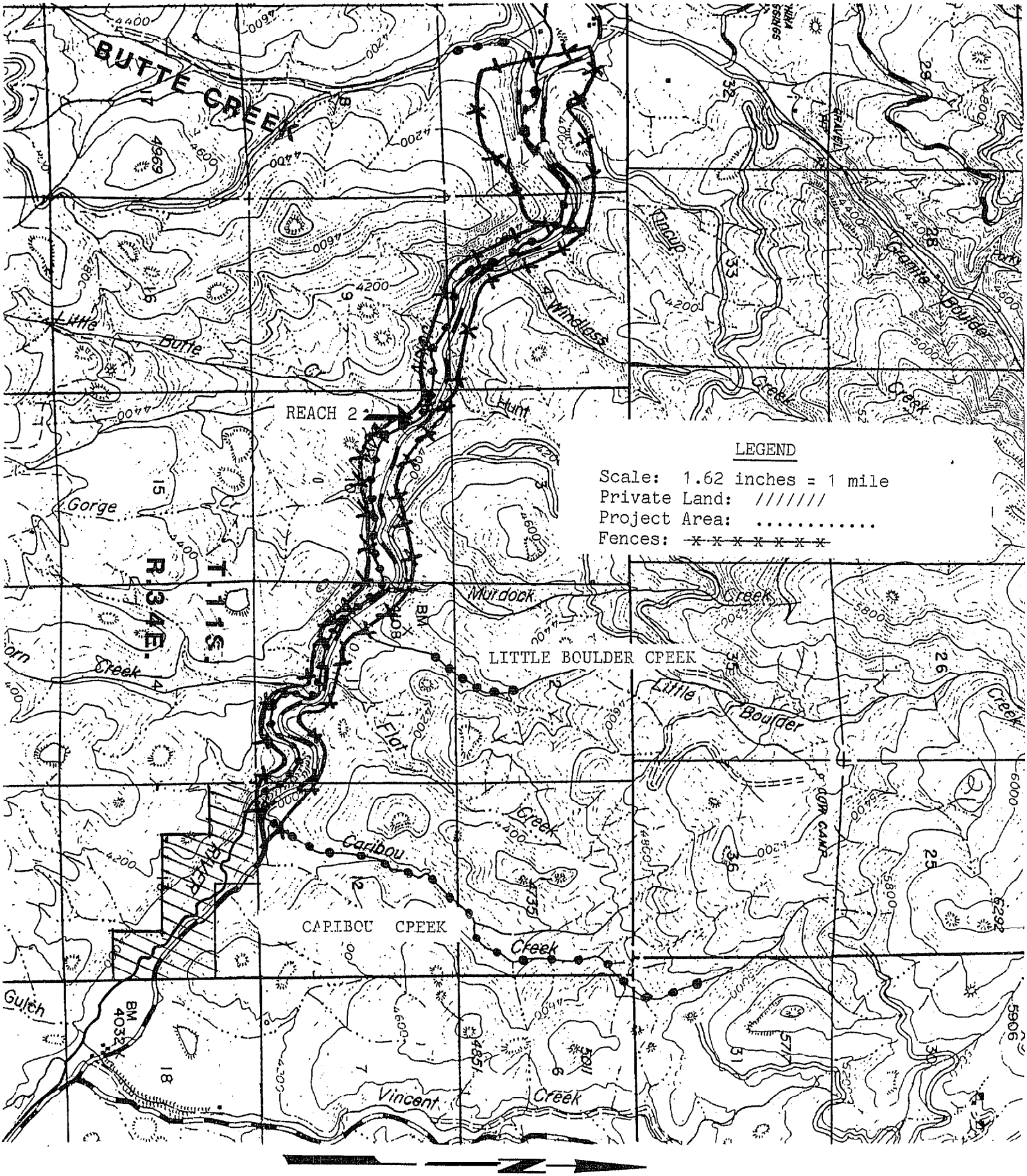


FIGURE 2


BUTTE CREEK
Little Butte Cr.
Windlass
Hunt
REACH 2
Gorge
Murdock
Creek
LITTLE BOULDER CPEEK
Little Boulder
Granite Boulder
Flat
Caribou
CARIBOU CPEEK
Gulch
Vincent
Creek
BM 4032
T. 11 S.
R. 34 E.
LEGEND
Scale: 1.62 inches = 1 mile
Private Land: ///////
Project Area: .....
Fences: x x x x x x x

upland and tributary areas, In the pastures, separate utilization rates for grasses and shrubs are established for the riparian areas. Among the objectives for these constraints on livestock grazing in the riparian area are improved riparian vegetation and fish habitat condition over time.

County Road 20 parallels the river from the old townsite of Bates downstream. In some areas, this road is in about the same location as the old narrow gauge railroad bed. The railroad crossed the river several times, but the County Road stays on the north side of the river. As a result, the railroad grade, which is listed as a historical site, is somtimes between the road and the river and sometimes on the other side of the river. This successive building of railroad and road beds has resulted in some encroachment on the river channel, It has also been the source of continuing sedimentation to the river. A portion of this County road is scheduled to be paved in 1988, and plans are to pave the entire road over the next few years. This should reduce the long term sediment input to the river from road maintenance and traffic dust.

Mining has also had a major impact on the MFJDR. Several reaches of the river have been dredged. As a result, vegetation was removed, most of the floodplain along these reaches of river were dug up and redeposited, with a resulting loss of much of the soil from the site, The river was usually moved and chsnnelized, which has increased stream velocity and resulted in channel scour and downcutting, In some cases the river was moved to the toe of a relatively steep slope, resulting in continued sedimentation as the river cuts at the toe of the slope during high flows,

The combined result of all of this activity is that the channel stability and fish habitat condition of most of the MFJDR above Big Creek is only fair, with some reachesin a poor condition. Habitat, conditions in most of the tributary streams have also been affected by similar activities, except that there was less mining activity and less intentional site conversion from timbered to pasture lands,

III. FISHERY CHARACTERISTICS

A. Historical and Current Production

The John Day Basin supports the largest remaining exclusively wild runs of spring chinook and summer steelhead in northeast Oregon, In 1987, over 30,000 summer steelhead and 4800 spring chinook returned to the basin. Of these totals, the MFJDR accounted for 9,000 sdeelhead (30%) and 1,600 salmon (33%). On average, the MFJDR and tributarieshas accounted for 24% of the chinook production and 30% of the steelhead production.

ODFW personnel first surveyed the John Day system for spring chinook and summer steelhead in 1959. Spawnstng ground summaries are shown in Tables IV and V. Few chinook redds were found in that initial survey. During the 1960's and early 1970's, redd counts in the basin increased. Summer steelhead counts remained fairly stable during this time+ with a peak of 16 redds per mile observed in 1966. Both salmon and steelhead counts started a downward trend in the late 1970's. There were undoubtedly many factors involved in the downward trend. The completion of the John Day Dam and expansion of The Dalles power house correlates to the period of downward trends and appears to be a principal factor in causing reduction in John Day chinook and steelhead escapement, Passage was a problem with both downstream migrating smolts and returning adults.

Returns of both spring chinook'and summer steelhead have indicated a recent upward trend, The 1986 surveys for chinook averaged 11.9 redd per mile and Steelhead averaged 10.9 redds per mile. The 1987 surveys show an even higher trend at 20.2 redds per mile for chinook and 11.4 redds per mile for steelhead. Improved passage at the Joh Day dam appears to be a major contributing factor to this recent increase in escapement. At the 'escapement levels of the last two years, habitat carrying capacity 'for juvenile steelhead and Chinook is probably very close to fully seeded. In '1987, seeding may have exceeded rearing capacity (E. Claire, ODFW District Fisheries Biologist). Sampling during 1988 will be needed to verify this estimate.

Most spring chinook spawn in the MFJDR above Mosquito Creek (RM 42). Juvenile rearing occurs in the MFJDR and tributaries, Summer steelhead generally spawn in tributaries with juvenile rearing occurring in both the tributaries and the MFJDR.

The John Day Basin supports locally important fisheries of summer steelhead, resident rainbow trout, and smallmouth bass. Some spring chinook are harvested in the lower Columbia River Indian ceremonial fisheries in April and May. Some chinook are probably caught in ocean fisheries but numbers are thought to be low (E. Claire, pers comm). The MFJDR supports an important summer steelhead fishery from U.S. Highway 395 (RM 25) downstream to the confluence with the North Fork John Day River.

Table IV *Steelhead Spawning Ground summary* a/

Twenty-Eight Year Periods

Year	Number of Streams Surveyed	Miles Surveyed	steelhead	Redds	Per Mile
1959	6	14.5	30	108	7.4
1960	10	22.0	60	194	8.Q
1961	8	24.5	56	166	6.8
1962	10	26.5	56	104	6.9
1963	11	30.5	47	216	7.1
1964	13	43.5	51	266	6.1
1963	19	45.0	88	344	7.6
1966	23	69.0	141	1,103	16.0
1967	25	78.0	61	905	11.6
1968	23	74.5	19	358	4.8
1969	27	91-5	76	806	8.9
1970	21	65.0	58	530	8.1
1971	8	22.5	18	181	8.0
1972	16	53.5	41	409	7.6
1973	25	76.4	22	402	5.3
1974**	14	38.0	4	167	4.4
1975**	14	34.0	21	302	6.9
1976	21	59.0	8	308	5.2
1977	30	75.5	69	535	7.1
1978	35	102.7	21	438	4.3
1979	29	78.7	4	81	1.0
1900	34	90.1	11	305	3.4
1981	33	86.1	12	319	3.7
19c2	32	71.8	34	301	4.2
1903	31	89.3	39	438	4.9
1784	29	76.7	33	299	3.9
1985	39	120.3	88	1,016	8.5
1986	42	117.6	127	1,206	10.9
1987	61	154.3	103	1,757	11.
To and Averages	560	1,580.5	1,154	10,653	6.8

Ninteen hundred arid Sixty eight Was low water with all absence of spring runoff. Irrigation took entire stream flows on several tributaries causing steelhead spawing escapement to be nill in some areas The poor count is reflected in redd/mile figure for that season.

**Courtts low due to high water in spring which smoothed out early redds and caused poor counting conditions.

a/ Data from Errol Claire, ODFW John Day District Fish Biologist

Table.V. Summary of Chinook Salmon Spawning Density
John Day District 1959 to 1987 (redds per mile) a/

Year	Bull Run Creek	Clear Creek	Granite Creek	John Day River	Middle Fk John Day River	North Fk John Day River	Average
1959	*	4.3	6.0	0.3	0.0	*	2.5
1960	*	16.3	10.0	0.7	3.2	*	7.5
1961	*	3.3	5.3	3.0	1.1	*	3.2
1962	2.0	49.7	44.2	12.2	2.8	*	22.2
1963,	7.0	29.2	26.4	0.8	0.4	*	12.7
1964	10.0	49.7	34.8	1.3	3.6	7.8	17.8
1965	7.5	16.7	24.4	5.8	3.7	8.1	11.0
1966	0.3	43.5	31.0	9.3	6.5	10.3	16.8
1967	6.0	38.5	19.4	7.4	1.7	5.5	13.0
1968	6.4	60.5	50.2	0.7	0.4	8.8	14.4
1969	15.6	13.7	16.8	9.3	4.8	20.5	13.3
1970	26.4	18.7	33.6	8.3	7.6	16.8	14.1
1971	11.6	18.8	31.2	7.0	4.1	11.8	11.5
1972	24.4	39.5	43.5	3.9**	5.1	10.5	14.2
1973	7.2	27.0	36.0	8.9	4.3	19.4	15.7
1974	7.6	8.0	25.5	2.5	8.1	7.2	8.2
1975	18.8	11.5	24.7	7.1	8.9	11.7	11.7
1976	9.2	7.0	20.2	4.6	6.6	6.2	7.5
1977	11.6	12.8	23.1	4.9	5.8	16.4	11.1
1978	12.4	6.3	19.8	4.5	10.7	5.9	8.3
1979	6.4	7.0	15.6	5.2	11.8	11.1	9.7
1980	1.2	7.0	8.5	1.2	5.8	4.3	4.3
1981	2.8	11.3	10.6	3.9	2.6	7,7	6,1
1982	5.2	10.8	12.0	3.8	6.2	5.5	6.4
1983	0.8	1.0	7.3	10.2	5.1	4.2	5.8
1984	3.2	2.0	5.8	5,6	6.7	3.5	4.4
1985	6.4	8.2	15.1	8.9	4.0	6.1	7.5
1986	2.4	11.5	21.0	12.2	6.3	13.3	11.9
1987	5.6	14.0	12.9	19.0	28.3	20.8	20.2

* No survey

** Count low due to rain and increased river flows which delayed survey and caused poor counting conditions

a/ Data from Errol Claire, ODFW John Day District Fish Biologist

Other game fish in the MFJDR include resident rainbow trout, cutthroat trout, bull trout, brook trout, and mountain whitefish. Non-game fish include suckers, northern squawfish, redsided shiners, fsvr, chiselmouth, and sculpins. The MFJDR and its tributaries also support an important trout fishery providing 2,000 - 3,000 angling days per year.

B, Habitat Problems - Limiting Factors

1, Passage Barriers

Falls, irrigation dams and road culverts can block or impede upstream passage of adults and juveniles into suitable spawning and rearing habitat. No passage barriers exist on the MFJDR proper. At the confluence of Caribou Creek and the MFJDR, passage for juvenile fish during low flows is not available, Juvenile chinook as well as steelhead cannot ascend Caribou Creek to take advantage of cooler waters during the summer low water - high temperature conditions. In 1987, ODFW personnel counted 4 steelhead redds on the lower l/2 mile of Caribou Creek; indication some adult steelhead had found passage. This passage problem is the result of past gold dredging operations conducted prior to the 1940's. It is the only passage problem addressed in this implementation plan, Problems at road culverts are being addressed through FS funding sources.

2. High Summer Water Temperatures

Summer water temperatures in some reaches of the MFJDR frequently exceed 80 degrees F. These high summer water temperatures reduce rearing habitat capability through direct juvenile mortality. Even at temperatures of less than 80 degrees, juvenive salmonids are displaced, that is they try to move out of these areas, Competition from warmwater tolerant species such as dace, squawfish, and suckers increases, Adult chinook also can suffer from high summer water temperatures as they must hold in the river from July through September awaiting cooler temperatures to spawn in September and early October. Two of the contributing factors to high water temperature are the wide, shallow channel morphology and lack of shade. Much of the riparian area on private lands is degraded due to livestock grazing and other activities such as gold dredging and logging. On National Forest lands, the riparian vegetation is generally in better condition, but riparian vegetation of sufficient size to provide substantial shade is still very limited.

3. Irrigation Water Withdrawal

The combination of natural low summer flows, reduced headwater storage due to reduced beaver populations, downcut channels and reduced vegetative ground cover and other factors all contribute to the existing summer low flow conditions in the MFJDR, There is currently insufficient flow on some of the streams to satisfy all water rights and minimum streamflows, due to the seasonal distribution of runoff, Water withdrawals compound water quality and temperature problems for salmonids and restrict habitat utilization, Unscreened ditches and lack of adequate headgates can also isolate and trap juvenile fish, especially during peak migration periods.

4. Lack of Habitat Diversity

Salmonids require a diversity of riffle and high quality pool areas to meet fresh water life history requirements for spawning and rearing. Disturbance of stream channels and associated riparian zones has resulted in wide, shallow channels characterized by a riffle dominated habitat. Habitat surveys on the MFJDR and tributaries generally show a 1:lO pool/riffle ratio with a very low level of large woody debris. Removal of large, woody debris has resulted in a loss of deep scour pools, instream cover, overhead cover and nutrient cycling. Within the boundaries of the Malheur National Forest lands in the MFJDR, which is covered by this implementation plan, habitat diversity is a major limiting factor limiting chinook and steelhead production,

5. Lack of Channel Stability

Throughout most of the MFJDR, the lack of channel stability has increased sediment loading and channel: width while decreasing effective cover and the quantity of pool habitat, In Reaches 2, 4 and 5, gold dredging operations have created very unstable banks, increasing sedimentation into the river, The river has also been channelized in several places as a result of dredging operations and railroad construction, with the upward trend in riparian vegetation, channel stability has improved and sedimentation has decreased. Overall conditions are still far less than optimum.

IV. DESCRIPTION OF DESIRED CONDITIONS - GOALS AND OBJECTIVES

The goal of the habitat improvement projects covered by this implementation plan for the MFJDR on the Malheur NF is to improve channel and instream conditions to increase the carrying capacity of the wild steelhead and chinook runs in this river. The objectives of the project are identified below, as they relate to the primary factors limiting rearing habitat quantity and quality, This is just part of an overall strategy for managing anadromous fish habitat in the MFJDR, Riparian area management, road management and other activities carried out by the Forest Service are covered by other Forest Service planning documents, and habitat restoration and improvement projects carried out as part of those plans do not require BPA funding and are not included here.

A. Passage Barriers

The objective is to provide unobstructed passage for migrations of adults and juveniles to achieve full seeding and utilization of suitable rearing habitat. On Caribou Creek, deflectors designed to concentrate flow and maintain channel depth will be constructed across the dredged area,

B. High Summer Water Temperatures/Livestock Management

The objective for water temperature is to move toward reducing summer water temperatures by a combination of instream structural treatments and livestock management. The proposed projects for BPA funding are targeted at accomplishing the instream structural work. The livestock management structures and strategies are already implemented. National Forest lands along the MFJDR are presently fenced into 5 pastures. (See Figures l-4.) A primary objective in each of these pastures is to continue to achieve an upward trend of riparian vegetation recovery, These fenced pastures are similar to riparian corridor fencing but are larger in size to allow limited grazing, Generally, the use on National Forest lands in these five pastures is limited to fall grazing during a short period of time when cattle are being gathered for removal off of National Forest lands, Utilization standards vary from no use to a maximum use of 45% allowed on grasses and forbs, The objective for shrubs is to restrict utilization to 10% attempting to leave 90%-100% of the annual leader growth on riparian zones throughout the MFJDR. Utilization standards and evaluation methods are described in USFS, Region 6, Forest Service Handbook 2209.21. The strategy for these fenced pastures is for less use than on adjacent National Forest lands, Maintenance costs of these existing fences are incurred by National Forest permittees. In portions of Reach 4 and Reach 5, cattle are permanently excluded from the riparian zone,

The management techniques employed with the 45% utilization standard have produced upward improving trends in the riparian zone. Camp Creek, a tributary to the MFJDR, was fenced in 1975. Instream structural improvement work was completed in 1982. The result has been a narrowing of the channel, stabilization of banks, decreased stream temperatures, and improved pool/riffle habitat, The management strategy for the MFJDR is the same as that which has been practiced on Camp Creek. It is expected the same results can be achieved.

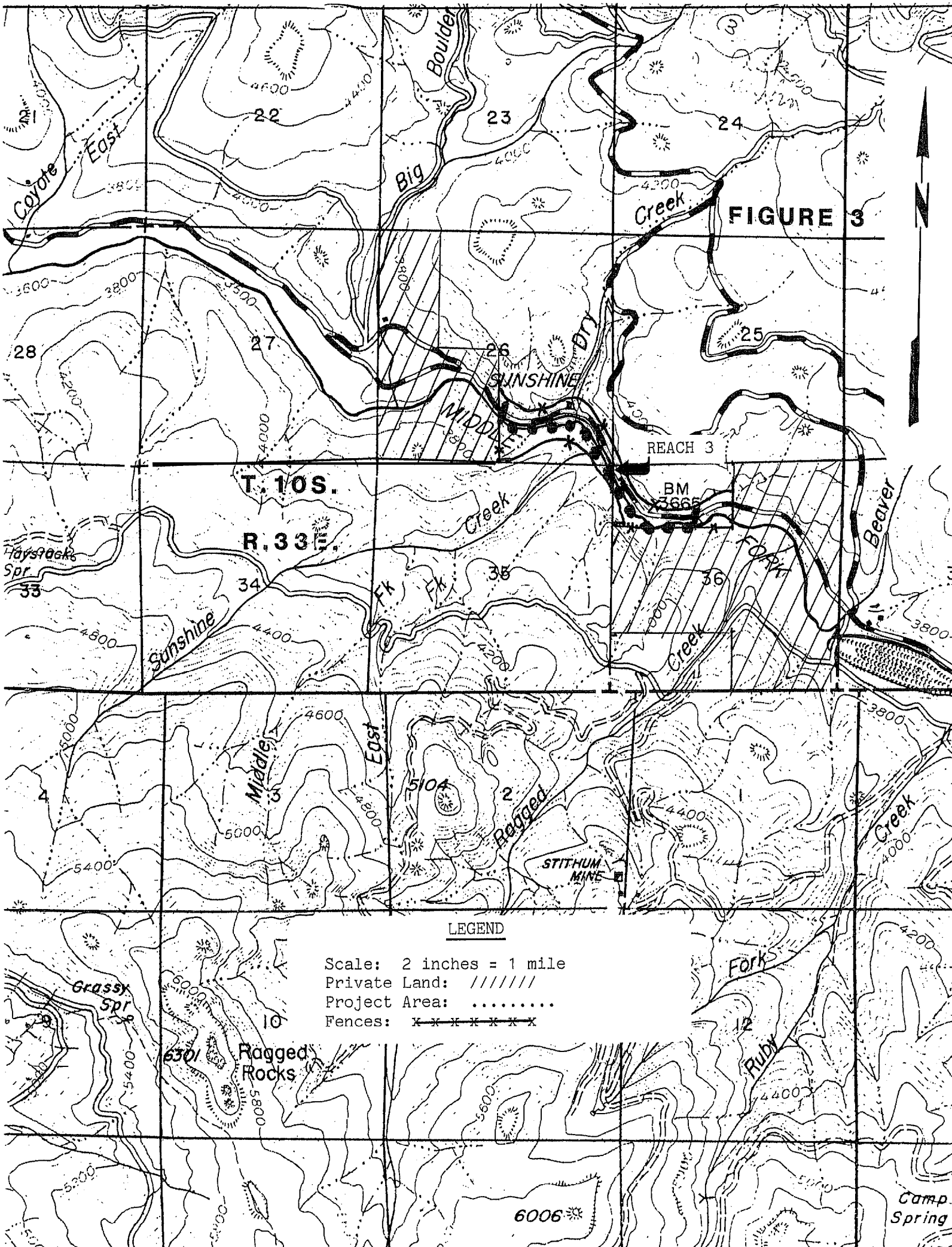


FIGURE 3
N
Coyote
East
Boulder
Big
Creek
Dry
SUNSHINE
MIDDLE
REACH 3
BM
3665
T. 10S.
R. 33E.
Haystack
Spr
Sunshine
Fk
Fk
Beaver
Creek
Middle
East
Ragged
STITHUM
MINE
Grassy
Spr
Ragged
Rocks
Fork
Ruby
Camp
Spring
6006
6301
5104
LEGEND
Scale: 2 inches = 1 mile
Private Land: ///////
Project Area: .....
Fences: x x x x x x x

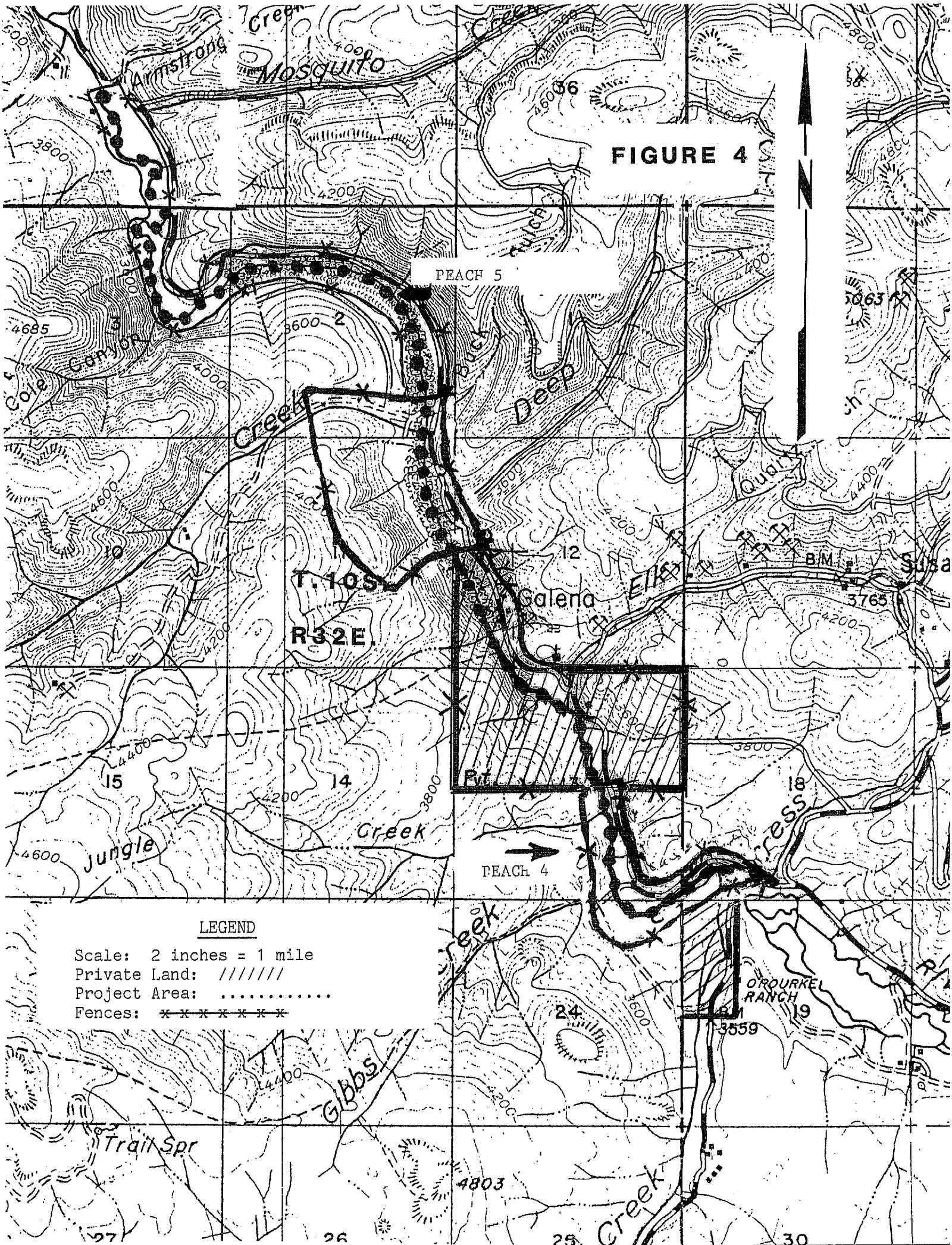


FIGURE 4
N
PEACH 5
PEACH 4
Armstrong
Mosquito
Creek
Cole Canyon
Deep
Creek
Galena
T. 10S.
R32E.
Pvt.
Jungle
Creek
Gibbs
Trail Spr
O'ROURKE RANCH
3559
4803
LEGEND
Scale: 2 inches = 1 mile
Private Land: ///////
Project Area: .....
Fences: x x x x x x x

C. Irrigation Water Withdrawal

Issuance of water rights is the responsibility of the watermaster. The ditches located on National Forest lands are subject to requirements as stipulated in special use permits and operating plans. The Malheur National Forest periodically reviews and identifies maintenance work required on all ditches. Operating plans must be submitted and approved by the Forest Service prior to use. In 1987, two new Oregon laws were enacted to protect fish statewide. One requires fish screens on all ditches where anadromous or resident trout exist, The other requires approved headgates on all ditches. The ODFW has been given the authority in enforcing these two new laws, Although not part of the programmed work to be accomplished in this implementation plan, these activities have a bearing on total fish production,

D, Lack of Habitat Diversity

The objective is to increase pool habitat to 20-40 percent of total stream area, To achieve this, instream structures such as boulder placements, cover logs, boulders, weirs, and log deflectors will be used to provide benefits of additional quality pool area, resting and escape cover, and increased edge effects. Additional diversity will also be provided by the current upward trend in riparian vegetation recovery. As streamside vegetation stabilizes banks, it also narrows the channel and provides stable undercut banks which provide overhead cover.

E, Lack of Channel Stability

The objective will be to provide for less than 20 percent,natural active erosion of stream banks, Channel stability will be enhanced by site specific location of log/rock deflectors, riprap blankets, and with the continuing upward trend of riparian vegetation recovery. In related Forest Service projects, road closures and rehabilitation activities are being conducted to reduce sedimentation,

VI. PROGRAM IMPLEMENTATION - RATIONALE FOR PRIORITIZATION

A. Rationale for Prioritization

Implementation activities have been prioritized based on the following:

1. Potential benefits and cost effectiveness.
2. Location within the subbasin.
3. Logistical considerations,
4. Funding sources.

Potential Benefits and Cost Effectiveness

The first criterion for identifying priority stream reaches and types of treatment techniques is to identify areas that have the greatest resource need and the greatest potential benefit for increasing suitable spawning and rearing habitat for anadromous fish. The strategy of the USFS on the MFJDR is to implement those projects that will provide immediate and long-term benefits while doing so in the most cost effective manner possible. Resolving passage problems has proved to be the most productive and cost effective type of project. Improving riparian condition rates high because of the, wide range of benefits for shade, channel stability, and habitat diversity. Types of structures which achieve more than one objective are generally more cost effective,

Location Within the Subbasin

The preferred approach for implementation is to treat streams from upstream downward, and in large contiguous sections to provide for positive, cumulative effects in downstream areas.

Logistical Considerations

Timing of activities plays a key role in prioritization of projects.The Malheur National Forest has made a firm commitment to fund as much fish habitat improvement work as possible from funding sources other than BPA, This should allow other agencies, such as ODFW, the opportunity to carry on programs during periods of restricted BPA budgets, Timing then becomes a factor, as is the case in FY 88. KV funds generated from timber sale receipts are available for fish habitat improvement work in FY 88. Little Boulder Creek and Butte Creek are two tributaries to the MFJDR scheduled for fish habitat improvement work in FY 88. Approximately one mile of Little Boulder Creek and one-half mile of Butte Creek are outside the sale area boundaries. The portions outside of the sale area boundaries are proposed for BPA funded work to be done in FY 88. This allows a more cost effective comprehensive approach to total fish habitat improvement work, Logistics, in availability of materials, has also prioritized treatment areas. Construction of Grant County Road 20 by the Federal Highway Administration has made available several areas of stockpiled boulders. A coordinated effort by ODFW and Malheur National Forest personnel has resulted in designation of boulders that will be used in the MFJDR. As road construction continues through the summer of 1988, the end result will be materials made available at no cost to both ODFW and the Forest Service. By delaying treatment on these reaches of the MFJDR until 1989 and 1990, both the Forest Service and ODFW programs will become more cost effective.

Funding Sources

The Malheur National Forest has generally followed the philosophy of requesting BPA funding to supplement other funding sources for fish habitat improvement work, Thus if we think we will be able to accomplish a project with K-V funding, or some other source\, within the next ten years, we have not identified it as a priority for BPA funding (see Table III).

B Priority Areas

The MFJDR subbasin has been identified as the highest priority stream in the John Day Basin for habitat improvement projects due to its great potential for increased production and the present severity of habitat conditions. The Malheur National Forest is coordinating extensively with ODFW personnel to provide a comprehensive approach to implementation of projects,

VI* IMPLEMENTATION SCHEDULE AND COSTS

Using the three listed prioritization factors, the Malheur National Forest plans to implement the schedule listed in Table 4. All BPA funded fish habitat improvement work is proposed to be completed by March 31, 1991. The Malheur National Forest plans to fund any remaining habitat improvement through other sources. A limited maintenance proposal is included for the period from April 1, 1991 to March 31, 1992, The John Day River Sub-basin Plan should be in effect by that time. Any future needs for BPA funding beyond March 31, 1992 will be included in that plan.

TABLE 4, Habitat Improvements Proposed for MFJDR and Tributaries in priority order and costs Fiscal Year" 1988~90,

Stream/Reach Priority	Fiscal Year	Treatment Miles	cost
Maintenance - existing improvements	88		5,600
MFJDR - Reach 1	88	2	31,870
Caribou Creek	88	""2 l/2	29,893
Little Boulder Creek	88	1	8,344
Butte Creek	88	1/2	5,421
TOTAL		6	81,128
** Includes passage at mouth			
Maintenance - existing improvements	89		5,600
MFJDR - Reach 2	89	4	**82,131**
MFJDR - Reach 3	89	1	20,535
TOTAL		5	108,266
Maintenance - existing improvements	90		5,600
MFJDR - Reach 4	90	1	25t564
MFJDR - Reach 5	90	4	102,256
TOTAL		5	133,420
Maintenance - existing improvements	91		5,600
GRAND TOTALS	88-91	**16**	**328,414**

The implementation schedule provides for treatment of 16 miles of stream habitat. Numbers of instream structures and specific data on locations by stream reaches are identified in the attached Statement of Work. The total cost for the proposed 16 miles of work is estimated at approximately **$306,000,** Out-year cost estimates are subject to modification. Significant cost savings may result from improvement in implementation efficiency.

VII. BENEFITS

It is important to note that because of the mixed ownership pattern, smolts produced in the MFJDR basin travel from private land to National Forest land and vice-versa during the juvenile rearing cycle and are, therefore, a product of both environments, Habitat improvement projects on private lands and National Forest lands, therefore, compliment each other and should be considered as interdependent projects,

Current and potential production estimates presented here are calculated the same way as was done for ODFW project proposals in the MFJDR. They are based on information presented by U.S. vs Oregon, and numbers from spawning counts, survival studies and habitat improvement evaluation studies by ODFW within the Jahn Day basin (Claire and Storch, 1977; Olsen, et al., 1984; Olsen and Lindsay, 1984). Based on these sources, the following assumptions were used to estimate current and potential chinook and steelhead production:

For Steelhead:
- 8,6- redds per mile
- 5,000 eggs per redd
- 7.5% egg to smolt survival at full seeding with current habitat conditions
- current rearing habitat capacity = 325 smelts-per mile
- potential increase due to enhancement ▫ 100% of current capacity

For Chinook:
- 12.2 redds per mile
- 4,000 eggs per redd
- 3% egg to smolt survival at full seeding with current habitat conditions
- current rearing habitat capacity = 1,465 smolts per mile
- potential increase due to enhancement = 100% of current capacity,

These estimates will be revised and updated when the John Day River Sub-basin Plan is completed,

Based on these assumptions, the potential fisheries benefits of the projects proposed in this implementation plan can be estimated as follows:

4 miles of tributary streams treated:
- at 325 steelhead smelts per mile ▫ an increase of 1,300 smolts

12 miles of MFJDR treated:
- at 325 steelhead smolts per mile = an increase of 3,900 smolts
- at 1465 chinook smolts per mile = an increase of 17,580 smolts

Total benefits = 5,200 steelhead smolts and 17,580 chinook smolts

In addition to increased fisheries production there will be: improvements to water quality (reduced sediment loads. and summer water temperatures); improved bank stability (resulting from'structural treatment and riparian improvement); and significant increases in the quantity and diversity of riparian vegetation which would benefit many wildlife species.

VIII, MONITORING

An important part of determining the effectiveness of habitat improvement activities is the assessment-of the success or failure of different improvement techniques and changes in fish production. Ongoing projects which are used for monitoring projects are:

1, Water quantity (effect log/rock weirs has on late summer water yield);
2. Riparian condition (through photo points and transects).
3. Stream surveys, measuring physical parameters such as pool:riffle ratio, overhead cover, channel stability, pool quality and substrate.

In addition, the Malheur NF is evaluating the macroinvertebrate production index method and other methods for implementation into FY 88 programs of work.

The monitoring of livestock use is accomplished by two methods. The first method involves inventory and analysis of the current year's growth on hardwoods and grasses. Grass and grass-like plants on control plots of ungrazed lands are clipped and weighed, The same procedure is then done on grazed lands, From the ratio of unused to used forage, a utilization rate is determined. The initial forage analysis is usually done midway through the grazing season. For example, if 50 cattle are turned out in an allotment unit on August 1 and a forage analysis is done August 10 showing 20% forage use, then it can be assumed that 40% of the forage will be utilized by August 20. The permittee is then required to remove or move his cattle to another pasture on August 20, if the utilization standard of 4045% is what is established in the operating plan. Generally, with these utilization standards on grasses, use of riparian hardwoods is very light. However, there is provision to move the cattle early if the use on the hardwoods exceeds the established standard.

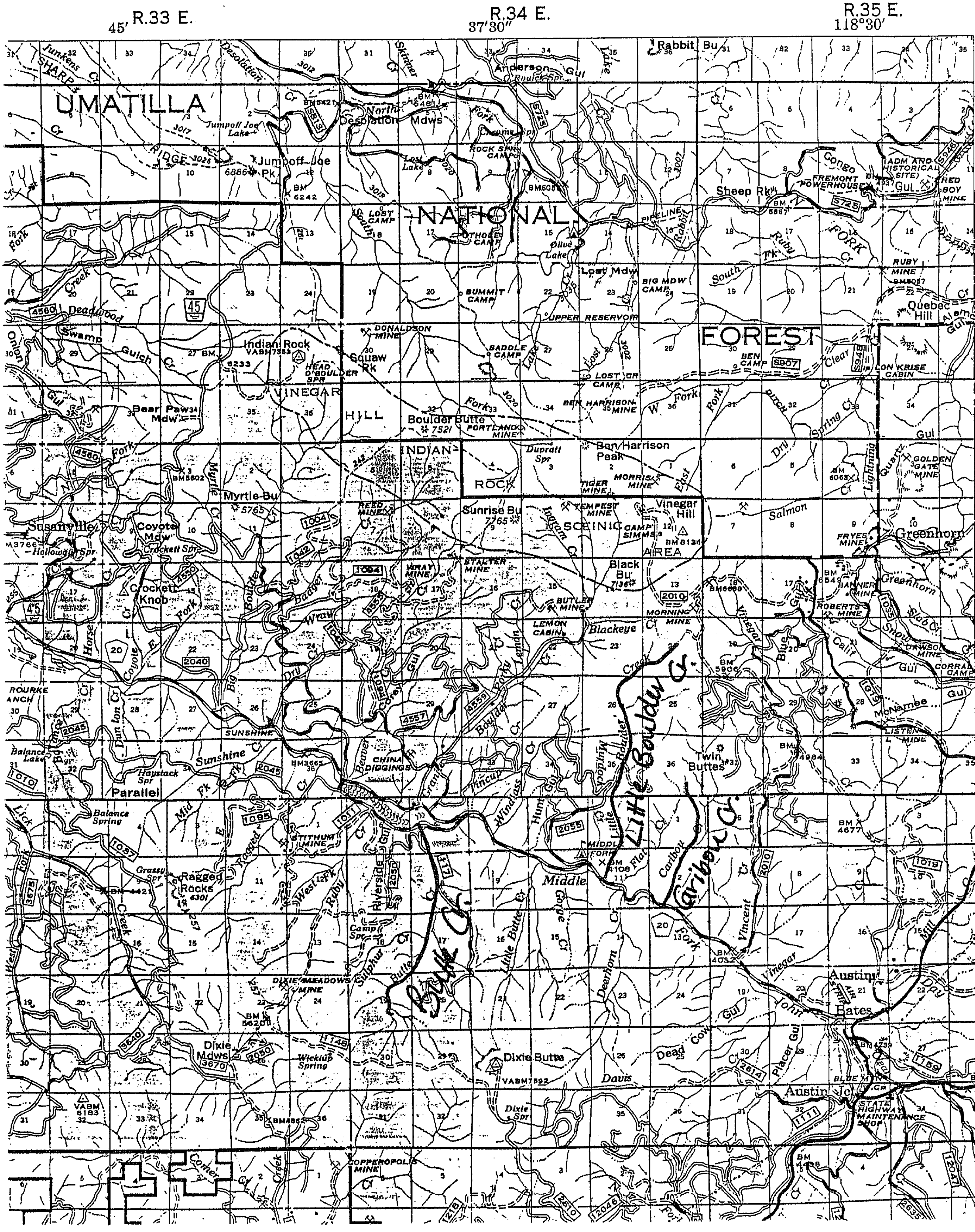
The second method of monitoring involves photo points and transects. Permanent photo points are established and line transects are done to gather information on shrub recuritment, bank stability, hardwood growth, species composition, etc. The photo points and transects are evaluated at 5 year intervals.

In a letter received 11-17-86, the Malheur NF was informed BPA had contracted with Campbell/Craven Environmental Consultants to review and analyze work done on habitat and passage improvement projects during fiscal years (FY) 1982 through 1984. It is assumed information regarding evaluation and monitoring programs will be made available to the Forest from studies such as these. The Malheur National Forest does not propose a separate monitoring program to be funded from BPA. While intensive biological surveyswill not be done as part of this program to document changes in fish populations, projects done on Camp Creek, Deer Creek and Clear Creek by ODFW indicate a positive response in fish populations to these types of treatments.

IX. FUTURE ACTIONS

The Implementation Plan should be, reviewed and updated or revised at least annually. Update/revision would occur through operational experience, project monitoring, and/or new technical information, With the drafting of the John Day Subbasin Planning document by the Northwest Power Planning Council, additional information may necessitate changes in the Implementation Plan.

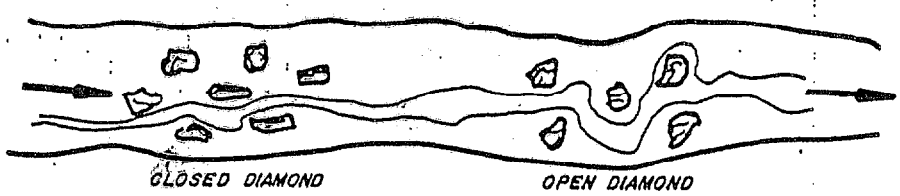
Figure 6

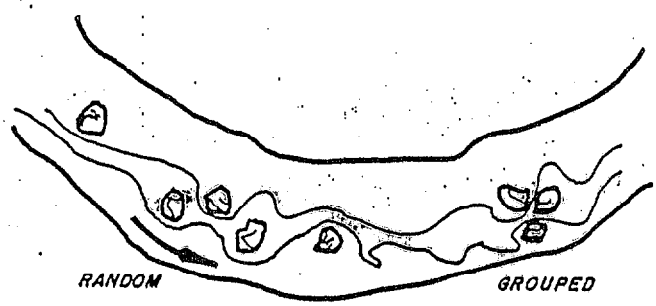

R.33 E.
R.34 E.
R.35 E.
45′
37′30″
118°30′
UMATILLA
NATIONAL
FOREST
Jumpoff Joe Pk
Jumpoff Joe Lake
North Desolation Mdws
Rabbit Bu
Anderson Gul
Sheep Rk
Congo Gul
FREMONT POWERHOUSE
ADM AND HISTORICAL SITE
RED BOY MINE
LOST CAMP
OTHOLEY CAMP
Olive Lake
Lost Mdw
BIG MDW CAMP
SUMMIT CAMP
UPPER RESERVOIR
RUBY MINE
Quebec Hill
Deadwood
Swamp Gulch Cr
Indian Rock
Squaw Rk
HEAD O'BOULDER SPR
DONALDSON MINE
SADDLE CAMP
LOST CR CAMP
BEN CAMP
CON KRISE CABIN
VINEGAR HILL
INDIAN ROCK
Boulder Butte
PORTLAND MINE
BEN HARRISON MINE
Ben Harrison Peak
Dupratt Spr
Bear Paw Mdw
Myrtle Bu
TIGER MINE
MORRIS MINE
GOLDEN GATE MINE
Salmon
Susanville
Coyote Mdw
Crockett Spr
Hollowa Spr
REED MINE
Sunrise Bu
TEMPEST MINE
Vinegar Hill
SCENIC AREA
CAMP SIMMS
FRYES MINE
Greenhorn
Crockett Knob
STALTER MINE
WRAY MINE
Black Bu
BANNER MINE
ROBERTS MINE
BUTLER MINE
LEMON CABIN
Blackeye
MORNING MINE
DAWSON MINE
CORRAL CAMP
McNamee Gul
LISTEN MINE
ROURKE RANCH
SUNSHINE
Sunshine Cr
Balance Lake
Haystack Spr
Parallel
CHINA DIGGINGS
Twin Buttes
Little Boulder Cr.
Balance Spring
STITHUM MINE
Grassy Spr
Ragged Rocks
Caribou Cr.
Middle Fork
Butte Cr.
Camp Spr
DIXIE MEADOWS MINE
Austin
Bates
Dixie Mdws
Wickiup Spring
Dixie Butte
Dead Cow Gul
Davis
Austin Jct
STATE HIGHWAY MAINTENANCE SHOP
Dixie Spr
COPPEROPOLIS MINE
Corner Cr

APPENDIX I

TYPICAL Structures

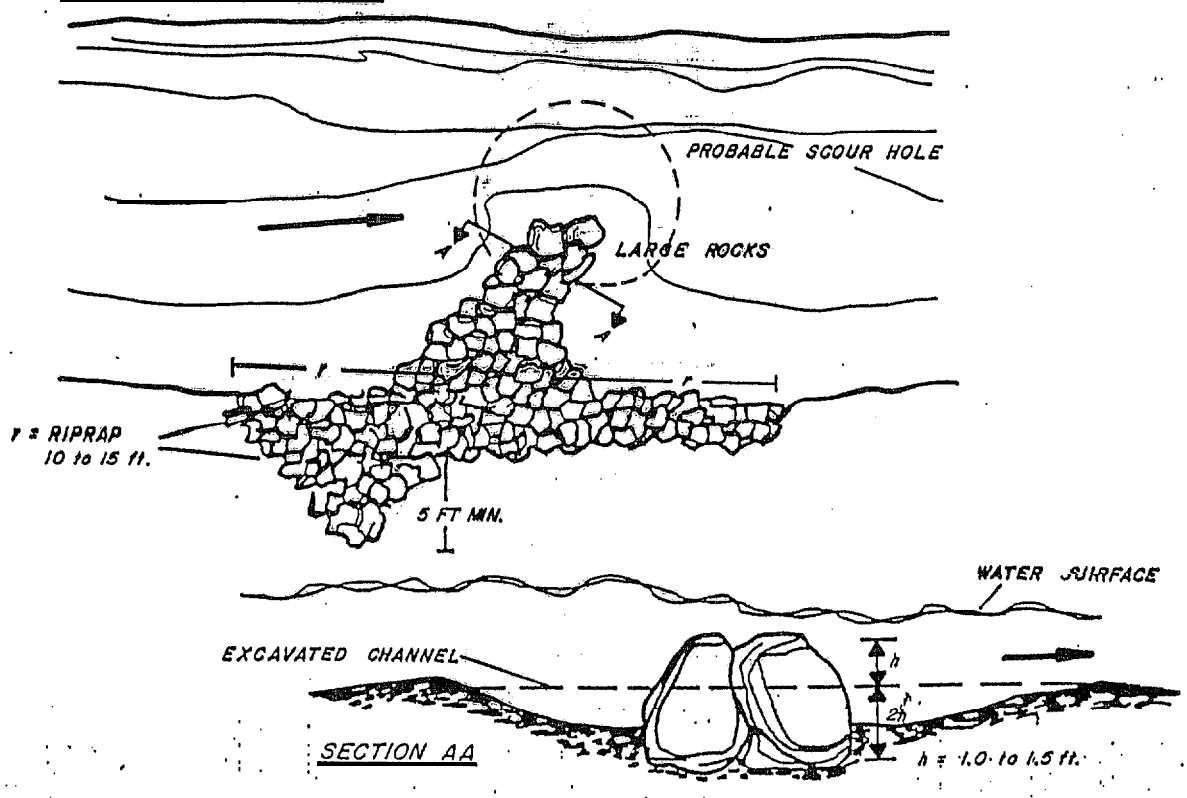
A. *Individually Placed Rock*



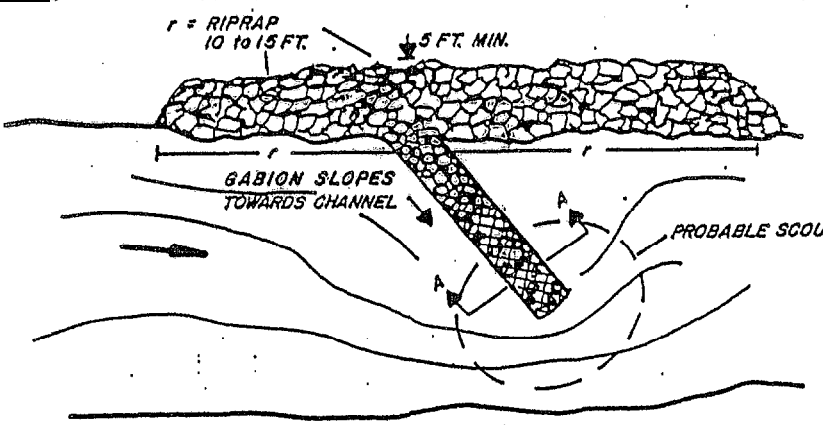


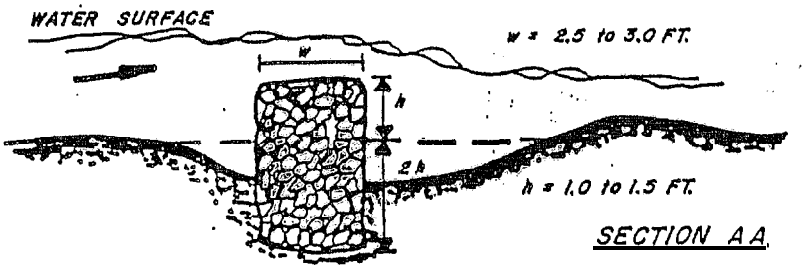
B. *Deflectors*

(1) ROCK DEFLECTORS



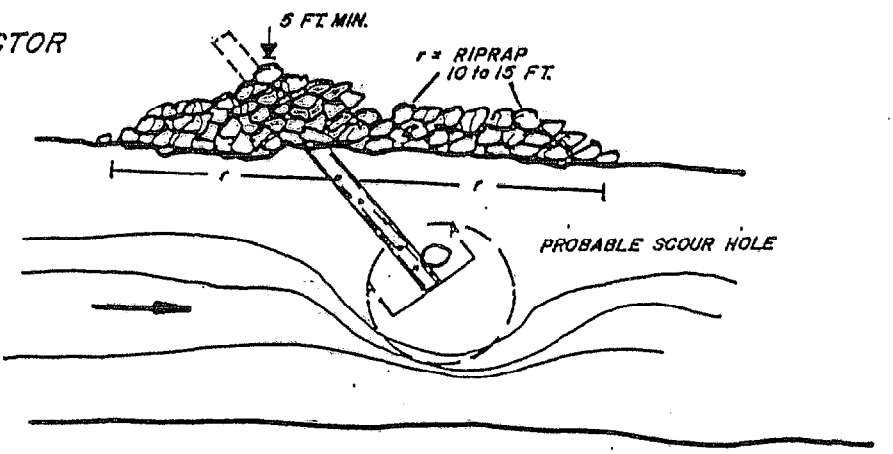
(2) GABION DEFLECTOR

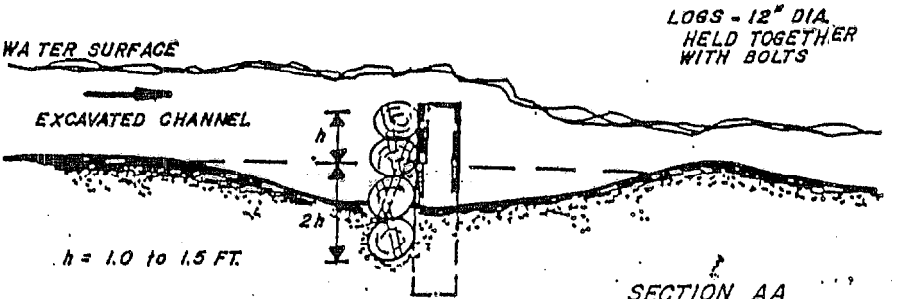




SECTION A A.

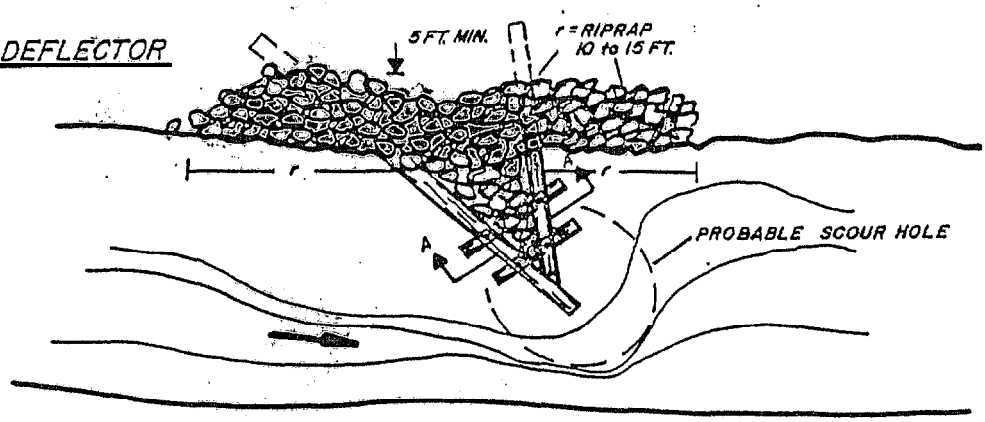
(3) LOG DEFLECTOR

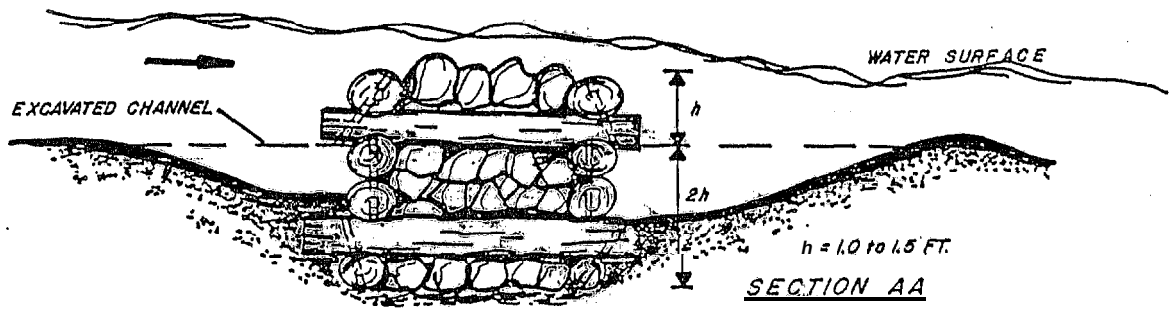




SECTION AA

(4) LOG CRIB DEFLECTOR

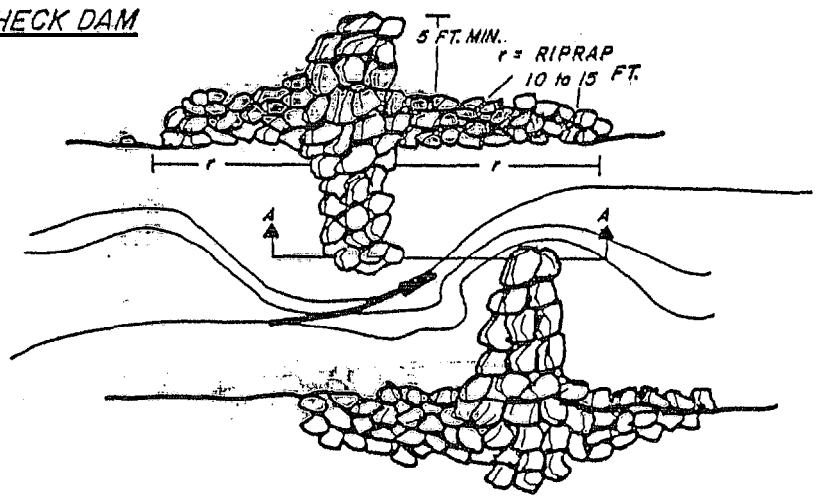


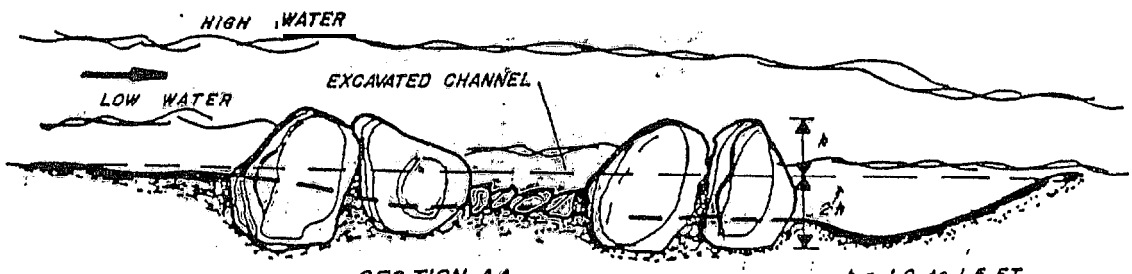


SECTION AA

C. *Check Dams*

(1) SPLIT ROCK CHECK DAM

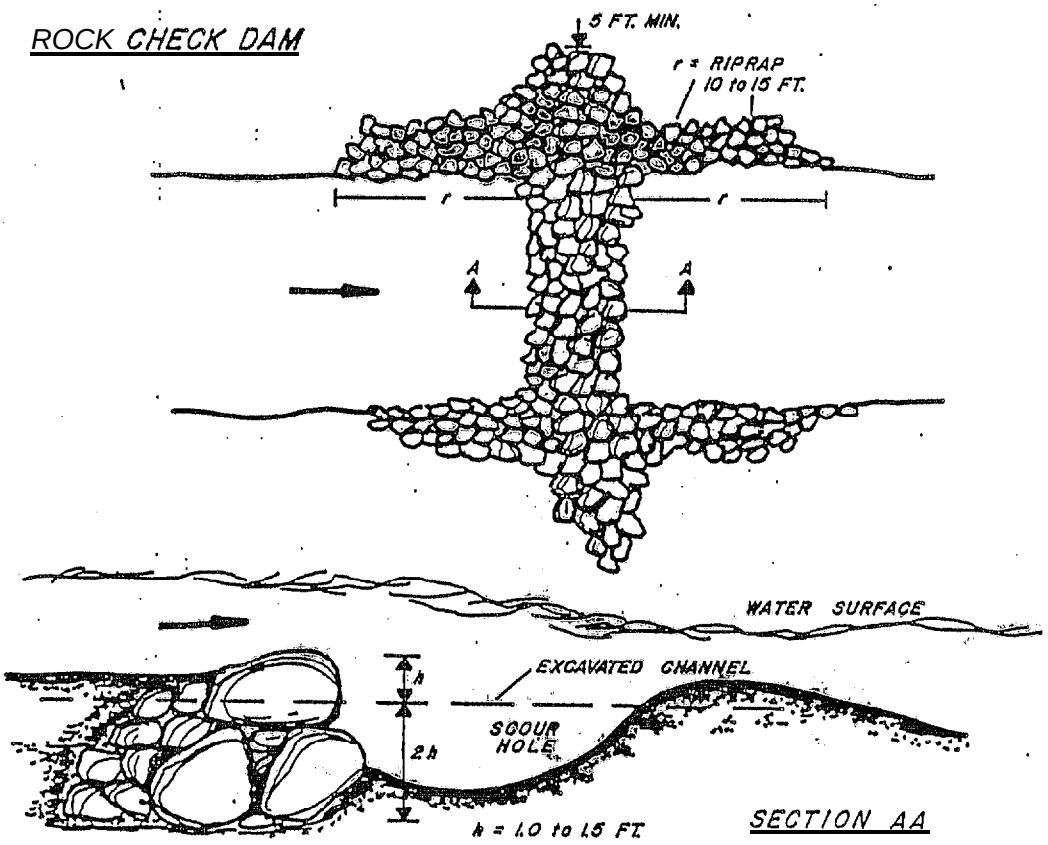




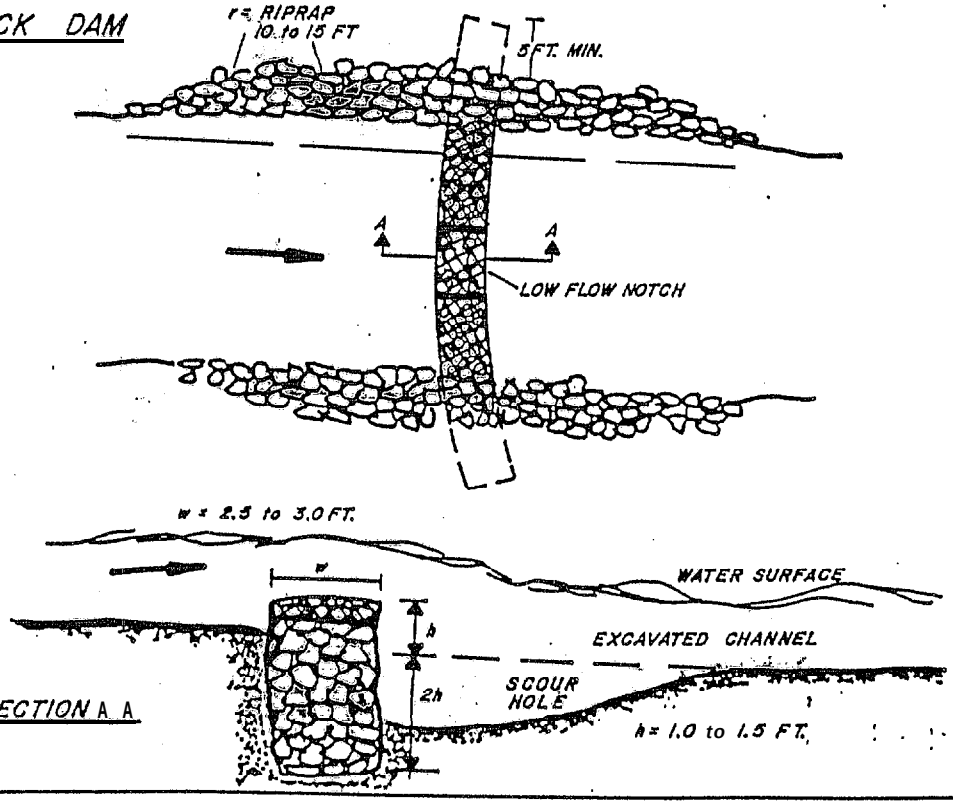
SECTION AA

h = 1.0 to 1.5 FT.

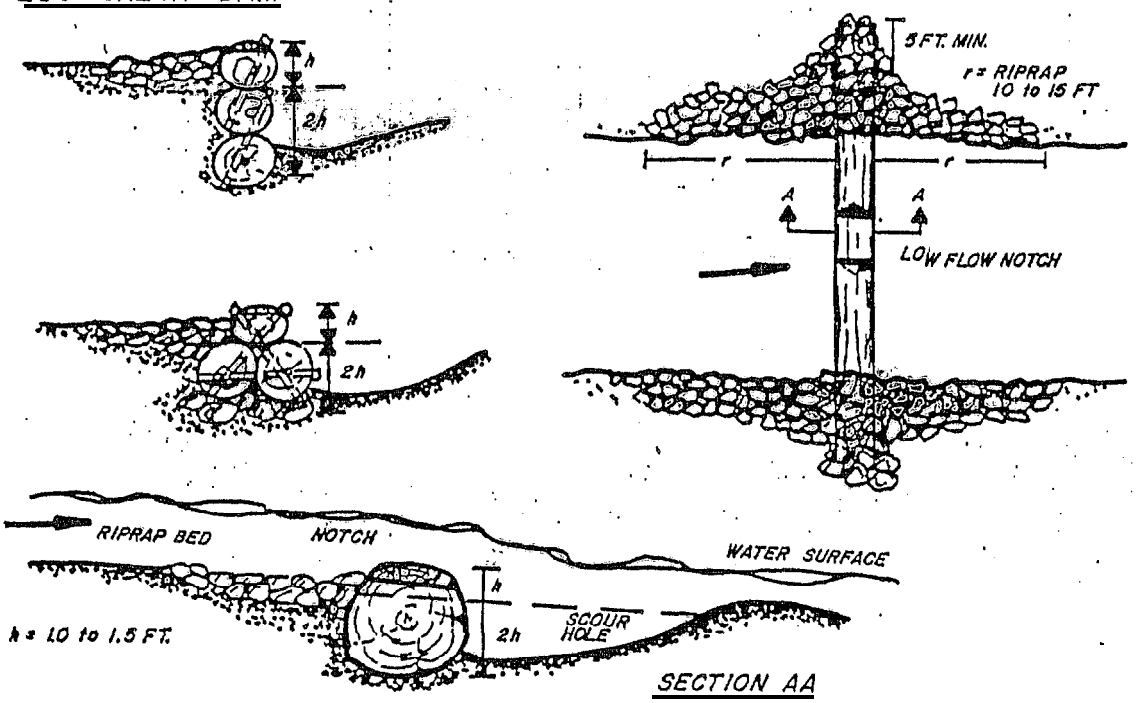
(2) ROCK CHECK DAM



(3) GABION CHECK DAM

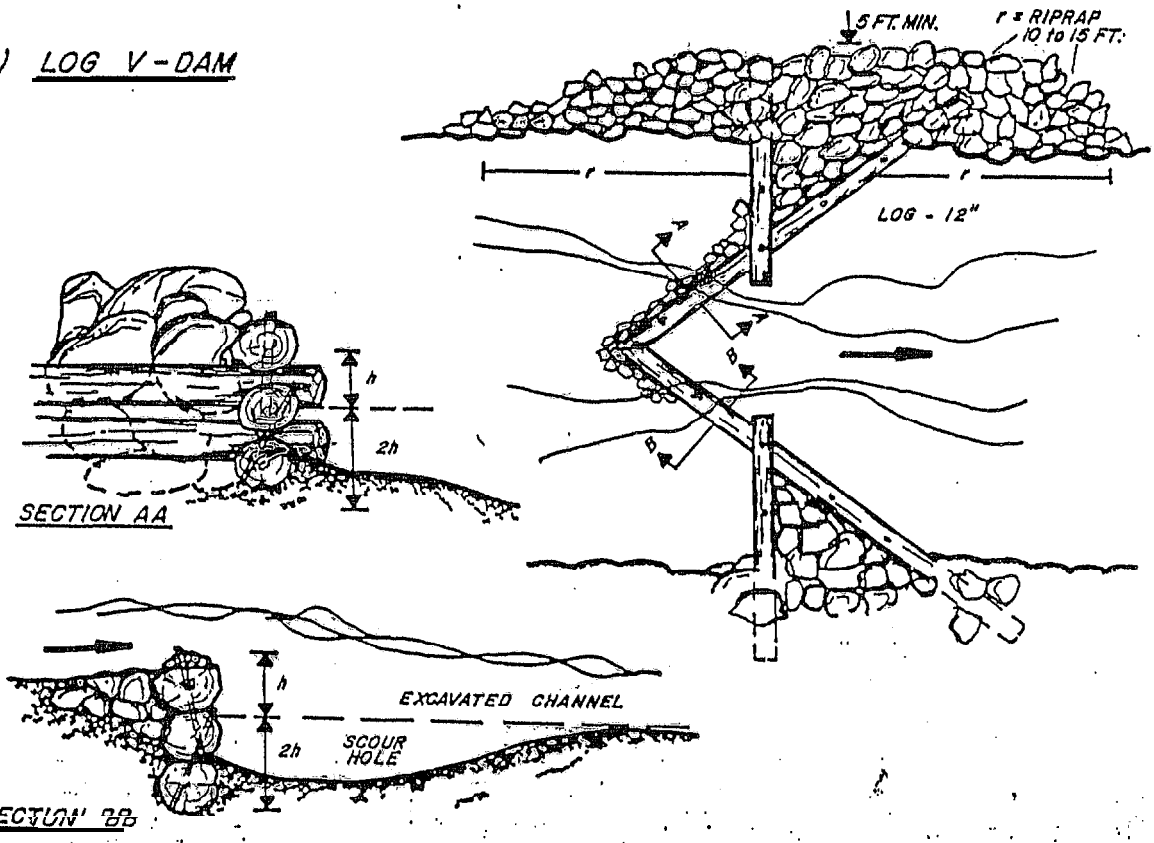


(4) LOG CHECK DAM



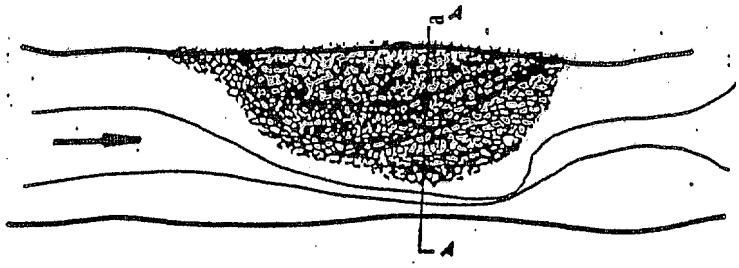
SECTION AA

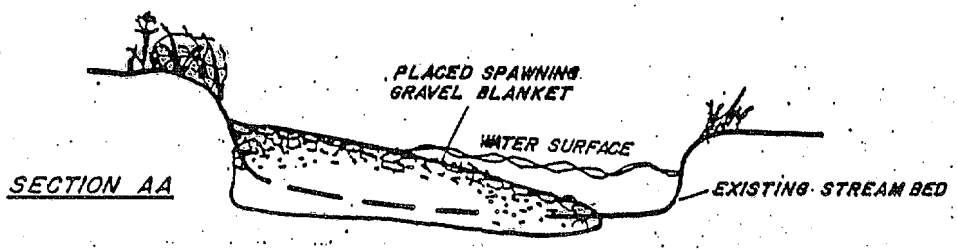
(5) LOG V-DAM



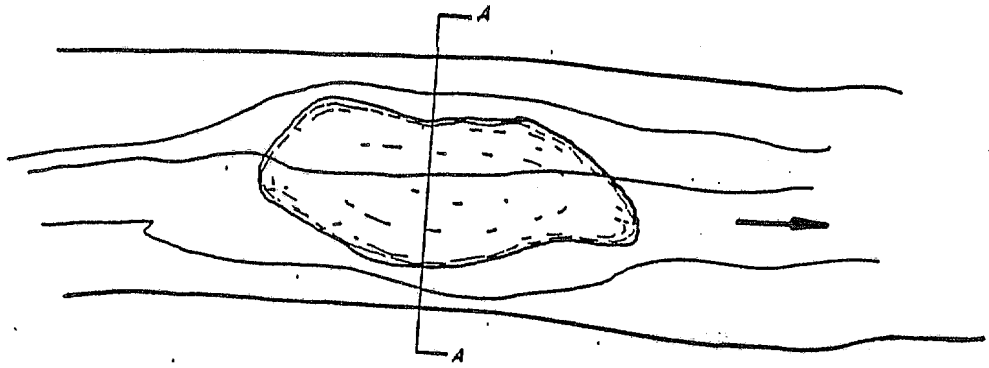
SECTION BB

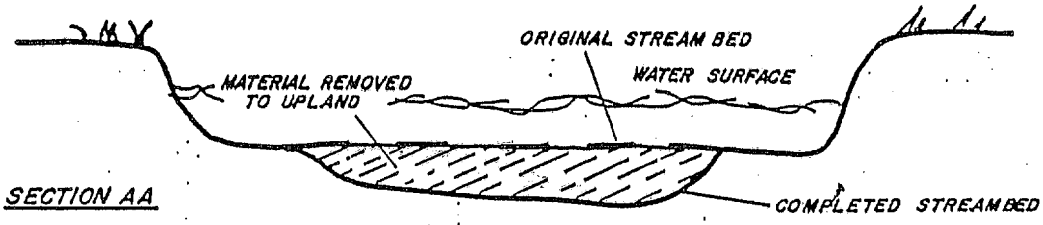
D. *Gravel Blanket*



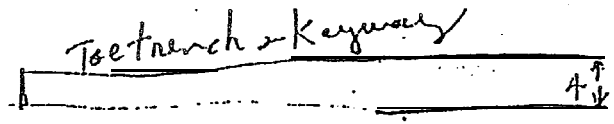


E. *Pool Construction*



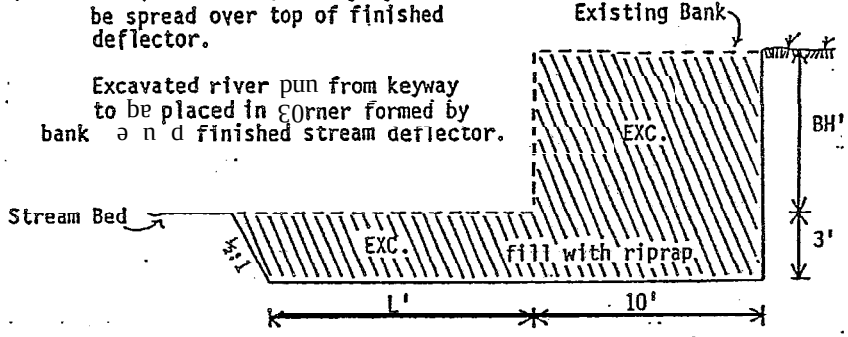


STREAM DEFLECTOR TYPICALS

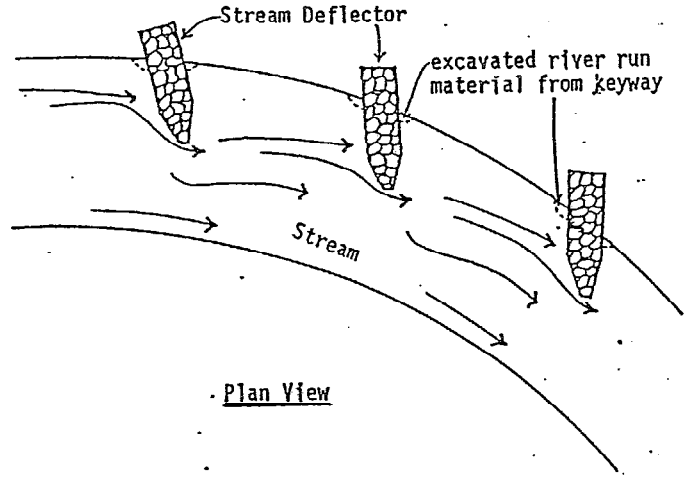


Note: Excavated soil from keyway to be spread over top of finished deflector.

Excavated river run from keyway to be placed in corner formed by bank and finished stream deflector.



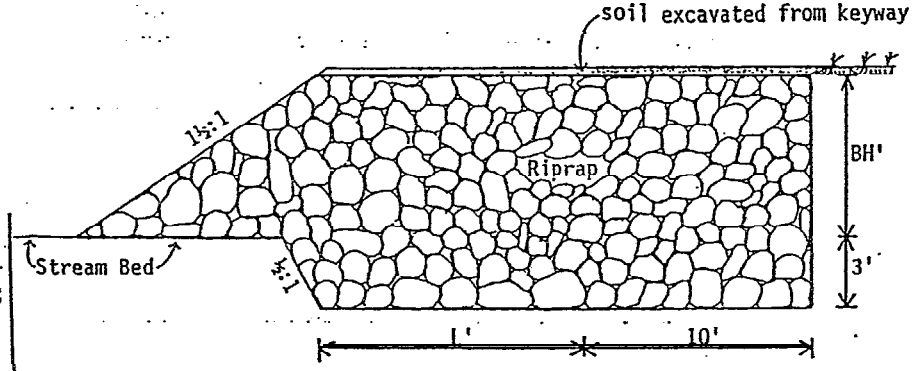
Keyway Excavation



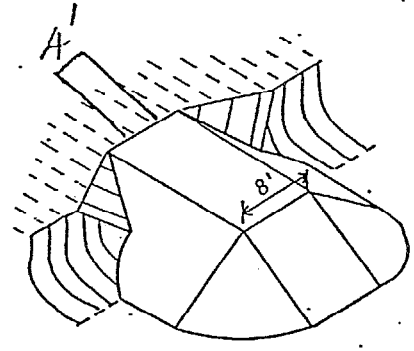
Plan View

BH=Vertical height from stream bottom to mean high water mark

L =Deflector length to be determined by COR to achieve the desired hydraulic effect.



Riprap Stream Deflector & Keyway



Slopes = 1½:1

Isometric View

NOT DRAWN TO SCALE